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EXPERIMENTAL STUDY ON PROPERTIES OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH SILICA POWDER AND FINE AGGREGATE WITH SAW DUST ASH

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ABSTRACT

Saw dust Ash (SDA) generated from rice mills is usually delivered to landfills for disposal. Using of sawdust ash in concrete is an interesting possibility for economy on waste disposal sites and conservation of natural resources .This paper examines the possibility of using sawdust ash as replacement in fine aggregate for a new concrete. Natural sand was partially replaced (5%, 10%, and 15%) with SDA. Compressive strength and Tensile strength (cubes and cylinders) on 7, 14 and 28 days of age were compared with those of concrete made with natural fine aggregate. Fineness modulus, specific gravity, water absorption, Bulk density for sand (S) and SDA were also studied. The characteristic compressive strength of concrete is M25. The test results indicate that light weight of concrete and it is possible to manufacture concrete containing sawdust ash with characteristics similar to those of natural fine aggregate concrete provided that the percentage of sawdust ash as fine aggregate is limited to 5% respectively.

Key words: Compressive Strength, Tensile Strength, Saw Dust Ash, Silica Powder.

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1. INTRODUCTION

Concrete is the most popular building material in the world. The Indian construction industry consumes about 400 million tonnes of concrete every year and it is expected that this may reach a billion tonne in less than a decade. The concrete materials are used in few years and the materials are reduced on the earth. So we have to using on the replacing of waste materials. Utilization of this material in different structures have placed a high demand for its constituent materials. In India river sand has been used as one of the major components of concrete since it is easily available and its well graded nature. River sand is mainly used for all kinds of civil engineering constructions. The excessive excavation of river sand is becoming a serious environmental issue. Hence it is necessary to explore possible alternative solution to minimize the use of river sand. Due to the continuous use of aggregate, river sand is facing a great scarcity and the production of concrete is degrading the environment. This constant extraction of river sand from the river bed for the construction purpose affects the storage capacity of the river and leads to severe water scarcity during lean seasons. This affects the living organisms in the river as well. So it is necessary to develop alternative materials for replacing natural river sand in concrete. The waste material that are available in the preparation of concrete are fly ash, rice husk ash, coconut shell, wood waste ash (or) saw dust ash, bottom ash, marble powder, copper slag, etc. During the last decades it has been recognized with growing sawdust ash waste are of large volume and that this is increasing year by year in the trees are removed from the forest and that are used for various purposes in construction such as for formwork, doors, windows, trusses, etc. Some of this waste is normally used as a fuel for cooking as well as for heating the rice mills, wood fired power plants and paper mills. One of the potential marginal materials suitable for replacing sand in concrete is saw dust ash. Sawdust ash is a product of intense sub aerial weathering. In Coimbatore a huge quantity of sawdust ash waste is produced in the near by rice mills and households are dumped. This waste storage disposals are becoming a serious environmental problem. Hence there is a need for recycling more and more waste material.

The most widely for fine aggregate for the making for concrete in the natural sand mined from the riverbeds. However, the availability of river sand for the preparation of concrete is becoming demand due to the excessive nonscientific method of mining from the riverbeds, lowering of water table, sinking of the bridge piers, etc. are becoming common treats. the present demands identification of substitute materials for the river sand for making concrete. The choice of substitute material for sand in concrete depends on several factor such as their availability, physical properties, chemical ingredients etc, SDA (sawdust ash) is one of the byproducts in burning sawdust not being used for any application other than filling-up.

Sawdust ash as fine aggregate is of particular interest, because their use can considerably reduce the problem of dumping and waste storage simultaneously helps the preservation of natural fine aggregate resources. There is however some obstacles for the use of sawdust ash aggregate in concrete. Codes limitations on water absorption and lack of knowledge about the behavior of concrete made of sawdust ash as fine aggregate. The first use of sawdust and shavings in place of sand and gravel to get a lighter and cheaper concrete.

Recent successful studies on the use of wood sawdust wastes as a new brick material supplement appears to be viable solution not only to the environmental problem but also to the problem of to economic design of buildings. Recent successful studies on the use of sawdust as aggregate in concrete have been reported in BMP Association Ltd. Sawdust ash concrete. In this study they represents that sawdust concrete has several unique characteristics which make it competitive among other building materials.

Some researchers carried out in the past used wood ash wastes as a replacement for cement in concrete mixes. Large quantity of wastes used in this research is currently disposed in sanitary landfills or open dumped into uncontrolled waste pits and open areas. This is a

worldwide energy loss and environment disposal problem. Disposal of this product waste is a major problem for many small businesses. Therefore, the acceptable solution of this problem with a commercial value is crucial.

The objective of this paper is to present the results of experimental investigations on Physical and Mechanical properties of concrete made with SDA concrete. Natural fine aggregate is substituted by weight by sawdust ash at rates varying from 5,10, and 15 percentages. Compressive strength, and tensile strength are evaluated from 7, 14 and 28 days of ages. Specific properties of concrete materials and SDA are also studied.

In additionally the concrete strength ingredient purpose to replacing the cement with in the silica powder. The silica powder was collected from the Mahaveer Minerals Industries from Malumichampatty, Coimbatore. The silica powder was to be taken from the laterite broken stones. The silica powder was used on the ceramics waste purpose. The silica powder is replacing in 25% of the Cement. In the silica powder is present in the cement is 30%. The work of the silica powder present in the cement to the purpose of due to the strength.

2. MATERIALS AND TESTING

The raw materials are used for this study are natural coarse aggregate, fine aggregate, saw dust ash, silica powder and 53 grades of Ordinary Portland cement (MAHA Cement). The SDA used for this study was collected from the SDA Warehouse (storage place) points in Sundarapuram at Coimbatore District. Sawdust Ash is shown in **Fig. 1.** Sawdust ash by open burning using a small construction area used to burn the Paddy shown in **Fig. 2.** SDA shown in **Fig. 4.** It was collected and sieve using to the sieve size from 4.75mm onwards **Fig. 3.** silica powder is shown in **Fig. 5. Table 1** shows the properties test of the cement. **Table 2** shows the initial properties test of Specific Gravity, Water Absorption, Bulk Density and Fineness Modulus results of Fine Aggregate, Coarse Aggregate, Saw Dust Ash, Cement and Silica Powder. The sand used for the study was locally available river sand conforming to grading zone III of IS:383-1970. The coarse aggregate was a normal weight aggregate with a maximum size of 20mm IS:456-2000. The control mix of the concrete was designed with a mix ratio of cement /water /Sand /Coarse of 1:0.45:1.37:2.34 by weight. This mix design yielded an average 28 days compressive strength 25 N/mm^2. The sand was replaced with 5%, 10% and 15% of SDA and cement was replaced with 25% of silica powder.

Figure 1 Sawdust Warehouse

Figure 2 Burning of sawdust ash

Figure 3 Sieve the SDA

Figure 4 Sawdust ash

Figure 5 Silica Powder

Table 1 Properties test of Cement

Parameter	**Cement**
Standard Consistency (%)	32%
Initial Setting Time (min's)	30
Final Setting Time (min's)	360

Table 2 Properties test of Materials

Parameter	F.A	C.A	SDA	Cement	S.P
Specific Gravity	2.46	2.57	2.75	3.16	2.2
Water Absorption (%)	3.5	1	_	_	_
Bulk Density (dry loose state) (Kg/m3)	1552.91	1468.25	373	_	_
Bulk Density (compact state) (Kg/m3)	1642.85	1711.64	489.41	_	_
Fineness modulus (%)	4.04	5.46	5.48	9	2

Cement

The cement used is Ordinary Portland Cement confirming to Indian Standards IS 12269 – 1987 of grade 53.The tests conducted on cement are standard consistency, initial setting time, final setting time, and specific gravity.

Fine Aggregate

The fine aggregates used are Ordinary river sand, saw dust ash partial replacement of fine aggregate. The tests conducted on fine aggregate are specific gravity test and particle size distribution test. The test results for different category of fine aggregate used in this project are as follows.

Ordinary River Sand

Ordinary river sand confirming to IS 383 – 1970 is collected from the nearby areas of Coimbatore.

A. Particle Size Distribution

IS Sieve designations of 10mm, 4.75mm, 2.63mm, 1.18mm, 600µ, 300µ, 150µ are used for testing the particle size distribution. The sieves are arranged according to the correct order and 1000g of sand is allowed for sieving. On completion of sieving the materials retained on each sieve together with any material cleaned from the mesh is weighed. The sieve analysis result for ordinary river sand is given in table 3. The grading curve is shown in Figure 6.

Table 3 Result of sieve analysis for ordinary river sand Fineness modulus = 4.04

S NO	IS SIEVE	WEIGHT OF PARTICLE RETAINED (g)	% WEIGHT RETAINED	CUMULATIVE %OF WEIGHT RETAINED	%PASSING
1	4.75mm	55	5.5	5.5	94.5
2	2.36mm	75	7.5	13	87
3	1.18mm	260	26	39	61
4	600µ	215	21.5	60.5	39.5
5	300µ	280	28	88.5	11.5
6	150µ	95	9.5	98	2
7	Pan	20	2.0	100	0

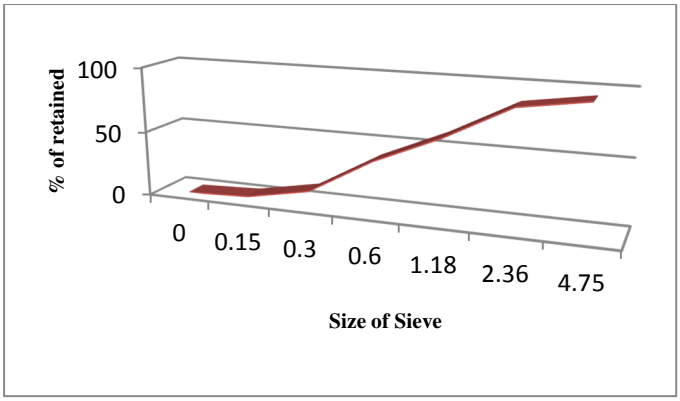

Figure 6 Grading curve for ordinary river sand

Saw Dust Ash

The saw dust ash is collected from the sundarapuram, coimbatore district.

A. Particle Size Distribution

The results for the sieve analysis – particle size distribution test conducted on saw dust ash as shown in Table 4. The grading curve for the result is shown in Figure 7.

Table 4 Result of sieve analysis for SDA

Fineness modulus = 5.48

S NO	IS SIEVE	WEIGHT OF PARTICLE RETAINED (g)	% WEIGHT RETAINED	CUMULATIVE %OF WEIGHT RETAINED	%PASSING
1	4.75mm	500	50	50	50
2	2.36mm	90	9	59	41
3	1.18mm	135	13.5	72.5	27.5
4	600µ	65	6.5	79	21
5	300µ	110	11	90	10
6	150µ	80	8	98	2
7	Pan	15	1.5	99.5	0.5

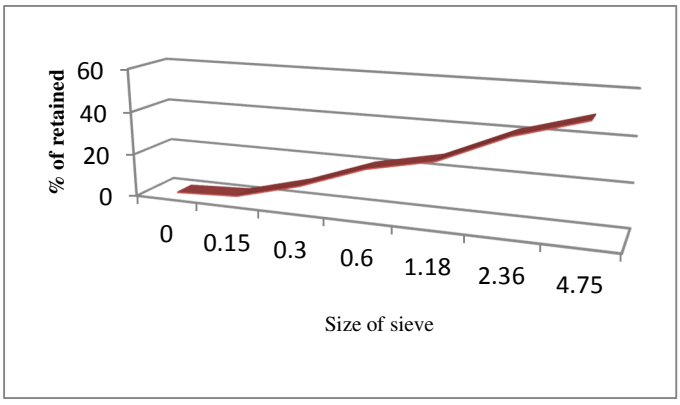

Figure 7 Grading curve for SDA

3. MIX DESIGN

The mix designs for the concrete replacing sand with saw dust ash and cement with silica powder has been calculated using the code for concrete mix design proportioning IS 10262-

2009. The target mean strength is set to be 40 N/mm^2. The mix ratios used for this work is M25 in 1:1.37:2.34.

4. STRENGTH OF CUBES AND CYLINDERS

Table 5 Strength of Cubes

Days	C.C	5%	10%	15%
7 days (N/mm^2)	16.22	16.08	17.37	17.73
14 days (N/mm^2)	22.48	22.84	19.2	19.51
28 days (N/mm^2)	24.71	25.12	21.24	20.17

Table 6 Strength of Cylinders

Days	C.C	5%	10%	15%
7 days (N/mm^2)	2.150	2.206	2.093	2.037
14 days (N/mm^2)	2.320	2.376	2.267	2.206
28 days (N/mm^2)	2.433	2.489	2.376	2.320

5. COMPARISON THE STRENGTH OF CUBES AND CYLINDERS

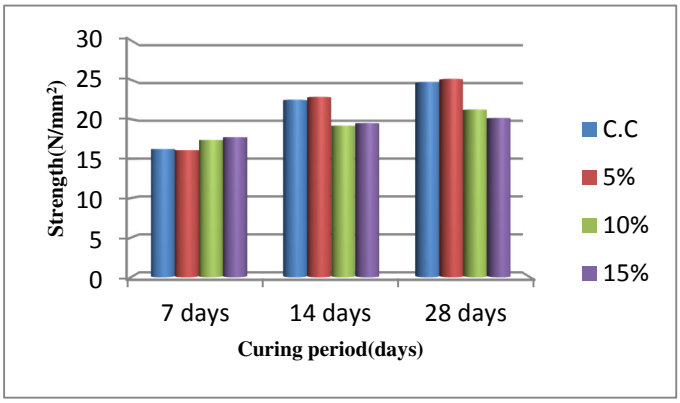

Figure 5.1 Comparison the Strength of Cubes

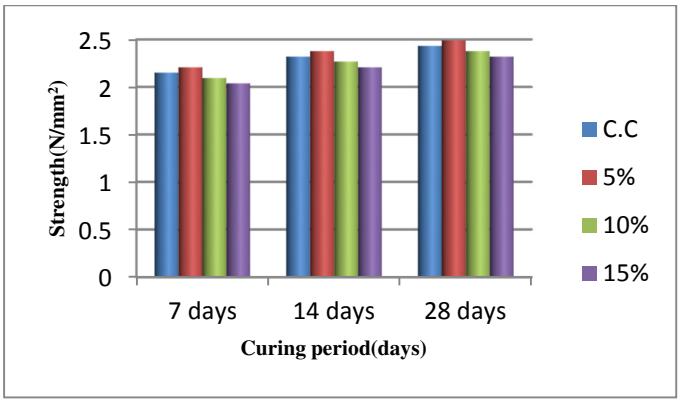

Figure 5.2 Comparison the Strength of Cylinders

The target mean strength assumed for the concrete is 25 N/mm^2. For traditional concrete the compressive strength achieved is 24.71 N/mm^2 which is 1.16% less than the target mean strength achieved on the conventional concrete at 28 days. When 5% replacing the concrete 28 days compressive strength of the concrete attains 25.12 N/mm^2 and the 7 days target strength

16.08 N/mm^2. From the studies conducted on using SDA as a sole fine aggregate it is found that fully replacing sand with SDA reduces the strength of the concrete. For concrete 10% replacing sand with SDA and SP of the concrete the target strength achieved on 28 days compressive strength test is 21.24 N/mm^2 and the strength achieved on 7 days compressive strength test is 17.37 N/mm^2. For concrete 15% replacing sand with SDA and SP of the concrete the target strength achieved on 28 days compressive strength test is 20.17 N/mm^2 and the strength achieved on 7 days compressive strength test is 17.73 N/mm^2. The grading curve for strength obtained by each mix combinations in 7, 14 and 28 days are shown in **Fig 5.1 and 5.2.**

6. CONCLUSION

The Project is observed by 5%, 10% and 15% partial replacement of Fine Aggregate with Saw Dust Ash and 25% partial replacement of Cement with Silica Powder. The 5% of Compressive Strength is more than the Conventional Concrete Target Strength.

The other percentage mix has a low Compressive and Tensile Strength this may be due to low bulk density of Saw Dust Ash. But literature says that Saw Dust Ash give good Strength if replacement with fine aggregate on Concrete.

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